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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Teat Cup Liner Construction

We, DAIRY EQUIPMENT COMPANY, a corporation duly organized and existing under the laws of the State of Wisconsin, United States of America, of 1444 East Washington Avenue, Madison, State of Wisconsin, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an improved teat cup for use in conjunction with milking machines used on milk-producing animals such as cows and goats. More specifically the present invention relates to improved teat cup liners or inflations.

A typical teat cup presently used with milking machines is illustrated in Fig. 1. Fig. 1 is a longitudinal section of such cylindrical teat cup after placement on the teat. As shown in Fig. 1, the commonly used teat cups include a rigid substantially cylindrical outer shell 1 usually made of metal. Inside the shell 1, there is an elastic, flexible tubular liner or inflation 2 usually made of soft rubber. The ends 3 of the inflation 2 are sealed to the shell 1 while the intermediate portion 4 of the inflation 2 is usually in radially spaced concentric relation to the shell 1. When used, such cup is applied to a teat 5 of the animal to be milked with the teat received within the upper section of the inflation 2 as shown in Fig. 1. The lower end of the teat cup is connected to a rubber tube 6 and milk is withdrawn from the teat under the influence of the vacuum in tube 6. The space 7 between the inflation 2 and shell 1 is connected to a pulsator rubber tube 8 by means of a nipple 9. Alternately space 7 is subjected to the same vacuum as in tube 6 and atmospheric pressure in order to cause periodic collapse of inflation 2 and thereby achieve the massaging action upon the teat which is essential to proper milking. The gently massaging action of the collapsing inflation is necessary to maintain blood circulation in the teat. In the absence of such massaging action, the vacuum exerted by tube 6 on the teat will cause an internal hemorrhaging condition in the teat which can seriously damage the teat.

As already noted, withdrawal of the milk from the teat is accomplished by the vacuum at the lower end of the teat. In order to ensure such vacuum, it is necessary that the upper part of the inflation be under tension in order to exert some external radial force on the teat so that the inflation is maintained in sealed relation to the teat. In the prior art inflations such tension is both longitudinal and circular and is set up by the longitudinal and circular stretching of the inflation by the teat. The prior art inflations actually rely predominantly on the longitudinal tension and normally require special tools to set up such longitudinal tension.

Irrespective of the type of tension used, it should be noted that the inner portion of the teat is an open tube through which the milk produced by the animal passes to the lower end of the teat. Consequently it is also necessary that the radial force exerted by the upper part of the inflation on the teat must not close such tube and block the flow of the milk to the lower end of the teat. Milk fills the hollow tubular portion of the teat after proper stimulation of the cow causes it to "let-down" its milk. However, before the milk is "let-down", the hollow tubular portion of the teat is void space. More important, after part of the milk has been removed from the teat, the hollow tubular portion of the teat has some void space above the remaining milk. While the teat cup is on the teat, such void space will normally be under vacuum. Consequently, an external radial force on the teat adjacent such void space such as that due to the inflation can cause the hollow tubular portion of the teat to close. Such closure in conjunction with movement of the teat causes the inner teat tissues to rub together and produces irritation lead-

ing to mastitis.

Proper milking technique will ensure that the teat cup is placed on the teat after the milk has been "let-down", thus any initial irritation period can be avoided. However, the irritation caused by closure of the teat above the remaining milk can only be avoided by properly locating the teat cup on the teat. If the teat cup is placed too high on the teat or if the teat cup "crawls up" the teat during milking, irritation and subsequent mastitis are almost certain to follow. In addition, if the teat enters too far into the teat cup, it will prevent the lower section of the inflation from completely collapsing and the essential massaging action and relief from vacuum will not be obtained at the end of the teat.

From these considerations, it can be seen that the proper location of the teat cup on the teat is of major importance for a successful milking operation. It should therefore be noted that in addition to maintaining a sealed relation between the inflation and the teat, the tension in the inflation in effect determines the location of the teat cup on the teat. When the teat cup is placed on the teat, its initial location is selected by the person making the placement. However, as the milking operation proceeds, the atmospheric pressure tends to force the teat further into the teat cup because of the vacuum below the teat in the teat cup, i.e. to cause the teat cup to "crawl up" the teat. Opposing such force, of course, is the weight of the teat cup. More important, the conical shape of the teat stretches the inflation as the teat enters further into the teat cup. Consequently the increased tension due to the stretching of the inflation soon counterbalances inward force created by vacuum and the teat cup remains at the point where such balance of forces is set up.

From the foregoing discussion, it is apparent that the tension in the inflation is of major importance in the proper operation of the teat cup. The tension, of course, is determined both by the initial size of the inflation and the force required to stretch the inflation longitudinally and circularly. Initially natural rubber was used in making inflations in order to maintain the desired tension. However, it was found that the butterfat in milk was absorbed by the natural rubber up to 10% to 15% of its weight due to its low oil resistance. Consequently, the natural rubber inflations would soon expand in size and lose their elasticity so that the proper tension was no longer maintained. Synthetic rubber was found to have a high resistance to butterfat, i.e. it absorbed butterfat to less than about 5% of its weight. However synthetic rubber inflations had much less elasticity than that of natural rubber and tended to permanently set in a stretched condition when expanded. Consequently, synthetic rubber inflations, although they lasted longer than natural rubber inflations did not maintain the proper tension nearly as well as natural rubber inflations. Compositions containing both natural and synthetic rubber are presently used; however, such compositions suffer from the defects of both natural and synthetic rubber.

The present invention involves a teat cup inflation which has both high oil resistance and high elasticity. Consequently the teat cup inflation of the present invention can maintain the proper tension over much longer time periods. In addition to overcoming the disadvantages of the prior art inflations, the present invention obtains several important advantages. The teat cup inflation of the present invention permits much more expansion of the inflation without additional tension and thereby obtains a much longer useful life. The teat cup inflation of the present invention may be used equally well on various sized teats to give the proper tension. The teat cup inflation of the present invention can be replaced in part as fatigue occurs and thus eliminates the requirement that the whole inflation be replaced. The teat cup inflation of the present invention relies almost solely on circular tension the minor amount of longitudinal tension used can be obtained manually without tools. Thus the teat cup inflation of the present invention can separately control the tension in its upper section without affecting the proper operation of the lower section. If the tension in the lower section becomes too great, then the lower section fails to collapse completely and thus to relieve the end of the teat from the vacuum. This fact, among others, limited the amount of longitudinal tension which the prior art inflations could utilize.

In general an object of the present invention is a teat cup inflation which has both high oil resistance and high elasticity.

Another object of the present invention is a teat cup inflation which can be replaced in part and can be used on various size teats.

Still another object of the present invention is a teat cup inflation which relies predominantly on circular tension and which can control the tension in its upper section with minimum resulting strain.

Other objects and advantages of the present invention will be readily apparent from the following description and the accompanying drawings in which are illustrated exemplary embodiments of this invention.

In general, the present invention is a teat cup inflation which comprises an upper section adapted to receive the teat of a milk-producing animal, said teat-receiving section consisting of an oil-resistant flexible material. Surrounding the upper part of said teat-receiving section is an elastic means extending longitudinally a substantial portion of the length of the upper part of the teat-receiving section and having a maximum inner perimeter substantially equal to the outer peri-

meter of the teat-receiving section prior to placement on said teat-receiving section. In addition, the present invention includes means for maintaining the elastic means in position surrounding the upper part of said teat-receiving section.

One feature of the present invention is the use of flexible material having high oil resistance such as synthetic rubber in the portion of the inflation which comes into contact with milk. Another portion of the inflation which is separated from the milk by the oil resistant material is utilized to give the inflation high elasticity. For example, a natural rubber sleeve surrounding the section made of synthetic rubber gives the structure as a whole both high elasticity and high oil resistance.

Another feature of the present invention is the use of separate means to give elasticity and support to the section of the inflation which is subject to the most stress and strain. Such means will normally become fatigued before other parts of the inflation. Consequently, the elastic means can be replaced when worn out without the main portion of the inflation requiring replacement.

Another feature of the present invention is the use of several different elastic means with various inner perimeters so that the teat-receiving section of a single inflation may be used with various teats of different sizes.

Still another feature of the present invention is the use of an elastic means only on the upper teat-receiving section of the inflation. In this way circular tension is added to the inflation only where it is necessary to prevent "crawl up". Consequently, no additional tension is added to the lower section where not only it is not needed but also it would prevent the lower end from collapsing properly and providing the necessary massaging action. Of course, the use of longitudinal tension necessarily results in tension in both the upper and lower sections. Likewise both the upper teat-receiving section and lower milk-receiving section of the inflation may have a thinner wall since the main support for the teat is supplied by the elastic means.

Still another feature of the present invention is the use of an elastic means whose inner perimeter is slightly smaller than the outer perimeter of the teat-receiving section prior to placement on the teat-receiving section. With this feature, the teat-receiving section may or may not loosely receive the teat prior to the placement of the elastic means. However, when the elastic means is placed on the teat-receiving section, the teat-receiving section becomes compressed and snugly receives the teat. When the teat-receiving section is then subjected to tension, e.g., when the teat cup tends to "crawl up" as the teat fills with milk, then it may expand but such expansion will usually only cause the teat-receiving section to return to its normal state, i.e., its uncompressed state. Consequently, by initially compressing the teat-receiving section of the inflation, the present invention can permit its expansion without subjecting it to tension. Further expansion can occur but still the resulting tension on the teat-receiving section is much less than normally obtained for the same total expansion without initial compression.

As already noted, Fig. 1 is a longitudinal section of the typical prior art cylindrical teat cup after placement on the teat.

Fig. 2 is a longitudinal section of a teat cup with one form of the inflation of the present invention.

Fig. 3 is a cross sectional view of Fig. 2 taken along the line III—III.

Fig. 4 is a cross sectional view of Fig. 2 taken along the line IV—IV.

Fig. 5 is a longitudinal section of a teat cup with another form of the inflation of the present invention.

Fig. 6 is a cross sectional view of Fig. 5 taken along the line VI—VI.

Fig. 7 is a side view of another form of the elastic means of the present invention, i.e., an elongated rectangular spring whose ends are attached together to form a circular expansion band.

Fig. 8 is a top view of the elastic means of Fig. 7.

In Figs. 2 to 4, the teat cup of the present invention includes a rigid outer shell 10 usually made of metal and an inflation 20. The shell 10 is connected to the pulsator rubber tube 11 by means of a nipple 12. The lower end of shell 10 flares inwardly to form a neck 13.

The inflation indicated generally at 20 includes an upper section 21 adapted to receive the teat of a milk-producing animal, a lower section 26 adapted to receive the milk from the teat and to periodically relieve the vacuum on the teat and an elastic sleeve 29. The teat-receiving section 21 of inflation 20 is surmounted by a rim 22. A lip 23 extends downwardly from the outer edge of rim 22. The inner surface of lip 23 is maintained in sealed relation with the outer surface of shell 10 by the stretching of lip 23 around shell 10. Flange 24 extends inwardly from the outer edge of rim 22 by a vertical section 24^1. The upper surface of flange 24 is maintained in sealed relation with the outer surface of the teat inserted in the teat cup by the stretching of flange 24 around the teat. Lugs 25 extend from the sides of the lower part of teat-receiving section 21. Lugs 25 provide means for maintaining the elastic sleeve 29 in position surrounding the upper part of teat-receiving section 21.

The lower milk-receiving section 26 of inflation 20 has two spaced annular ridges 27 and 28 between which neck 13 of shell 10 is seated. The outer surface of milk-receiving section 26 is maintained in sealed relation with the inner surface of neck 13 by the compress-

ing of milk-receiving section 26 with neck 13. In addition, lower section 26 has longitudinally extending walls 26^{11} with normally flat opposing internal surfaces that are spaced apart only a slight distance over substantially their entire area. It should be noted that both teat-receiving section 21 and milk-receiving section 26 are usually maintained in slight longitudinal tension by stretching them lengthwise between the upper and lower ends of shell 10. Milk-receiving section 26 has an extension 26^1 which is connected to a vacuum source (not shown) and a container (not shown) for the milk withdrawn from the teat.

In Figs. 5 and 6 another form of the inflation of the present invention is illustrated. In Figs 5 and 6, the inflation 30 has an upper section 31 adapted to receive the teat of a milk-producing animal, a lower section 32 adapted to receive the milk from the teat and to periodically relieve the vacuum on the teat and an elastic sleeve 33. Inserted in the lower section 32 is a transparent connection 34 which conducts the milk from lower section 32 to an extension 34^1. Extension 34^1 is the conduit to a vacuum source (not shown) and a container (not shown) for the milk withdrawn from the teat. Lower section 32 is itself inserted in a metal collar 35 so that a tight seal between connection 34 and collar 35 is formed by lower section 32. Collar 35 has circumferential grooves 35^1 in which an elastic ring 36 may be seated. A tight seal between collar 35 and shell 37 is formed by ring 36 when upper section 31 of inflation 30 is placed on shell 37 and inflation 30 is stretched so that ring 36 is seated against flange 38 of shell 37. The plurality of grooves 35^1 permit adjusting the amount of longitudinal tension imposed on inflation 30.

In the form of the inflation in Figs. 5 and 6 the sleeve 33 extends below the end of the teat and terminates in a tapered portion 33^1 which curves inwardly. Tapered portion 33^1 aids maintaining sleeve 33 in position when lower section 32 of inflation 30 is periodically collapsed. In addition, inflation 30 has a circumferential ridge 39 for maintaining sleeve 33 in position.

In Figs. 7 and 8, an elongated rectangular metal spring joined at its ends to form a cylindrical expansion band 40 is illustrated. Band 40 may be used in place of sleeve 29 on the inflation 20 or sleeve 33 on the inflation 30. Band 40 is rectangular so as to distribute the force exerted by the spring when stretched substantially equally over the widest possible area and so as to permit greater expansion at the top. In this way, concentration of the tension so as to cause pinching of the teat is avoided.

In accordance with the objects of the invention, both the teat-receiving section and the milk-receiving section of the inflation are made of an oil-resistant flexible material. Such material need not have a high elasticity. Synthetic rubber such as Neoprene, Buna-N and Buna-S have been found to be satisfactory. Likewise the elastic means which provides the main support for the teat in the teat cup may be made of a flexible material having high elasticity. Elastic means such as a natural rubber sleeve or an elongated metal spring have been found to be satisfactory.

It will be noted that the elastic means such as the rubber sleeve or metal spring may be removable from the teat receiving section. Consequently when they become fatigued, only that part of the inflation need be replaced. Likewise, if a single teat-receiving section is used with teats of various sizes, the elastic means may be replaced accordingly. Such adjustment insures the proper fit of the teat cup and prevents "crawl-up" on smaller teat sizes. If desired, the elastic means may have a conical form to conform to the shape of the teat. In this way, the tension throughout the elastic means is equalized and excessive fatigue at the top of the elastic means is avoided.

In accordance with another object of the invention, the inner perimeter of the elastic means is preferably slightly smaller than the outer perimeter of the teat-receiving section. When the elastic means and teat-receiving section both have a circular cross section, it has been found that having the inner diameter of the elastic means about one-sixteenth inch smaller than the outer diameter of the teat-receiving section gives excellent results for milking cows. Differences of more than about one-eighth inch have also been found satisfactory. If desired, the inner diameter of the elastic means may be about equal to the outer diameter of the teat-receiving section. However, it should not be substantially larger since then the elastic means would not provide proper support for the teat and would permit "crawl-up."

It should be noted that small lugs on the teat-receiving section such as lugs 25 in Figs. 2 and 3 provide a simple means for maintaining the elastic means in position surrounding the upper part of the teat-receiving section. In place of such lugs a circumferential ridge may be used as in Figs. 5 and 6 or a circumferential groove with a mating ridge on the inner surface of the sleeve. Likewise, the elastic means may be maintained in position by a spacer sleeve between it and the junction of the inflation with the shell. Also the elastic means itself may have an extension so that it is supported by the junction of the inflation and the shell. If desired, the elastic means may also be maintained in position by actual bonding to the teat-receiving section with an adhesive or by vulcanization. In any event, it can be seen that the elastic means may be maintained in position by any convenient means.

As already noted, the teat cup inflation

of the present invention permits the use of thinner walls and lower tension in the lower milk-receiving section, which may have longitudinally extending walls with normally flat opposing internal surfaces that are spaced apart only a slight distance over substantially their entire area as shown in Figs. 2—4. In this connection, it should be noted that the teat cup inflation of the present invention need not initially have a circular cross section. For example, the inflation may initially have a "clover-leaf" cross section which conforms to the shape of the teat when placed on the teat. Also, as shown, the teat cup inflation of the present invention may consist of one piece contacting the milk as in Figs. 2—4 or multiple pieces contacting the milk as in Figs. 5 and 6. One piece inflations have the advantages of economy and simplicity. The multiple piece inflation has the advantages of being able to adjust the longitudinal tension and permitting direct observation of milk flow from the teat.

WHAT WE CLAIM IS:—

1. A teat cup inflation comprising: an upper section adapted to receive the teat of a milk-producing animal, said teat-receiving section consisting of an oil-resistant flexible material; elastic means surrounding the upper part of said teat-receiving section, said elastic means extending longitudinally a substantial portion of the length of the upper part of the teat-receiving section and having a maximum inner perimeter substantially equal to the outer perimeter of said teat-receiving section prior to placement on said teat-receiving section; and means for maintaining said elastic means in position surrounding the upper part of said teat-receiving section.

2. The teat cup inflation as stated in Claim 1 wherein the inner perimeter of said elastic means is slightly smaller than the outer perimeter of said teat-receiving section prior to placement on said teat-receiving section.

3. The teat cup inflation as stated in claim 1 wherein said teat-receiving section is substantially cylindrical in shape prior to placement on the teat.

4. The teat cup inflation as stated in claim 1 wherein said elastic means consists of a sleeve of material having an elasticity higher than said teat-receiving section material.

5. The teat cup inflation as stated in claim 4 wherein said sleeve is removable.

6. A teat cup inflation comprising: an upper section adapted to receive the teat of a milk-producing animal, said teat-receiving section consisting of an oil-resistant flexible material; elastic means surrounding the upper part of said teat-receiving section, said elastic means extending longitudinally a substantial portion of the length of the upper part of the teat-receiving section and having a maximum inner perimeter substantially equal to the outer perimeter of said teat-receiving section prior to placement on said teat-receiving section; means for maintaining said elastic means in position surrounding the upper part of said teat-receiving section; and a lower milk-receiving section having longitudinally extending walls with normally flat opposing internal surfaces that are spaced apart only a slight distance over substantially their entire area so as to be capable of very quickly being brought into surface-to-surface engagement as a consequence of relatively slight inward movement of said walls due to the application of inflation collapsing force to their exteriors.

7. The teat cup inflation as stated in claim 6 wherein said upper and lower sections are joined by an intermediate junction section, said intermediate junction section having a cross sectional shape which gradually merges the upper and lower sections so that in the event the teat length is less than the length of the upper section, the lower part of the upper section below the end of the teat collapses and takes the cross sectional shape of the lower section.

8. A teat-cup inflation substantially as described with reference to Figs. 2 to 4, 5 and 6, or 7 and 8 of the accompanying drawings.

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FIG. 1.

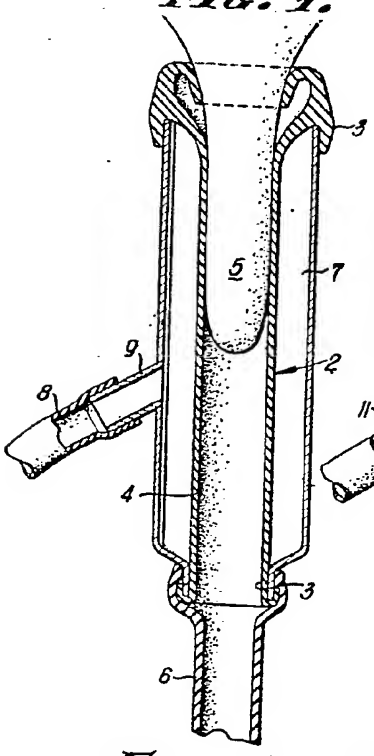

FIG. 2.

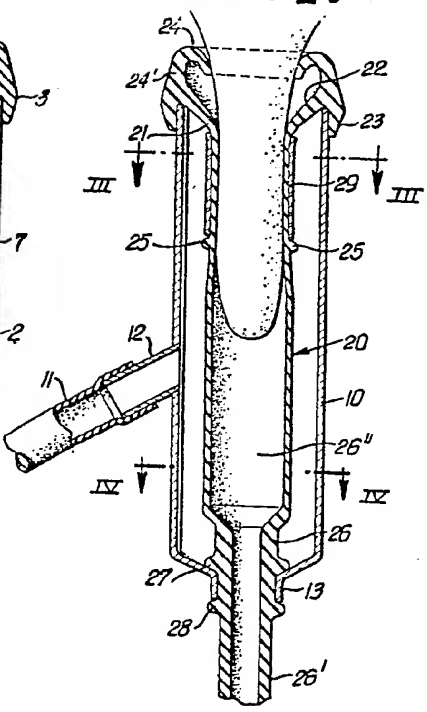

FIG. 4

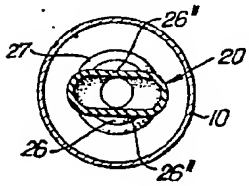

FIG. 3.

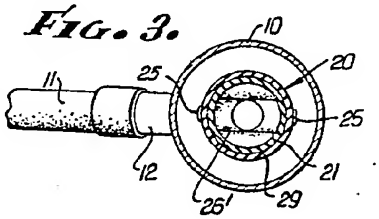

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Fig. 2.

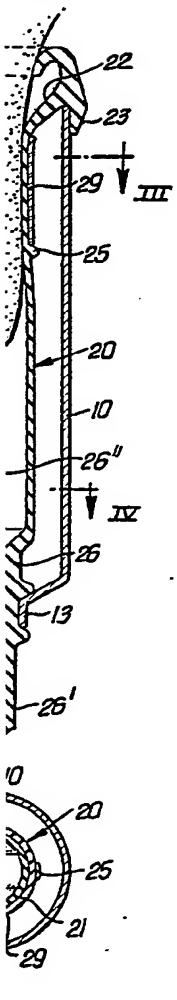

Fig. 5.

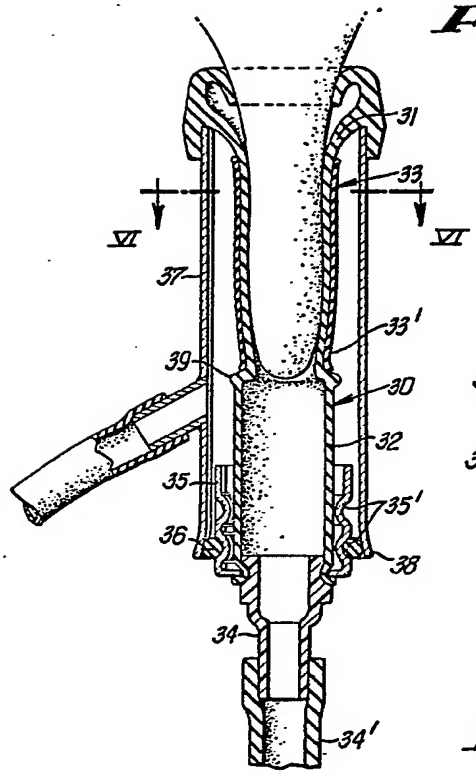

Fig. 6.

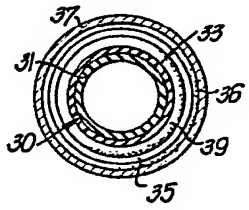

Fig. 7.

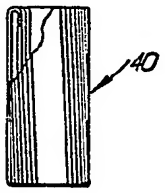

Fig. 8.

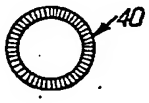

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Fig. 1.

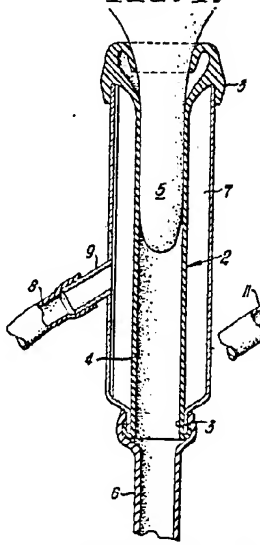

Fig. 2.

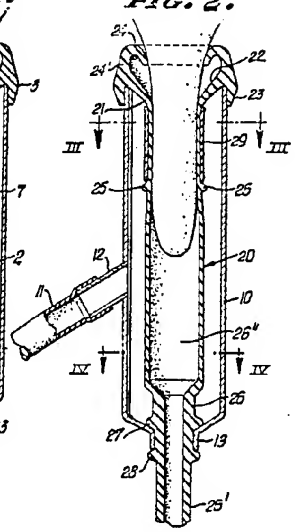

Fig. 5.

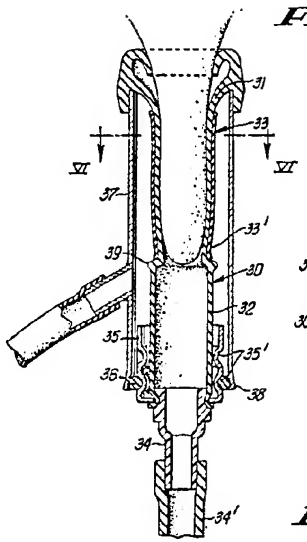

Fig. 6.

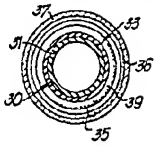

Fig. 4

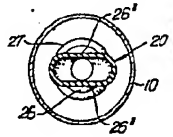

Fig. 3.

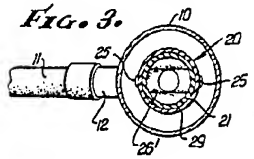

Fig. 7.

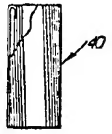

Fig. 8.